PHYTOCHEMICAL IMPORTANCE OF SOME MEDICINAL PLANTS AS SOURCE OF ANTICANCER AGENTS

कैंसररोधी कारक के स्त्रोत के रूप मे कुछ

औषधीय पादपो के पादपकीय रसायनिक महत्व

A SYNOPSIS SUBMITTED FOR THE REGISTRATION OF DEGREE OF DOCTOR OF PHILOSOPHY IN BOTANY

(FACULTY OF SCIENCE)

TO

M.D.S UNIVERSITY AJMER

2016

Supervised by :

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Appendix IV

Maharshi Dayanand Saraswati University, Ajmer

Certificate By Supervisor

Certified that :

1. I am willing to guide the research work of **Smt. ANNU BHARDWAJ** on the above subject if he/she is registered for Ph.D.
2. To the best of my knowledge, the subject selected has not been studied and is not being studied so far in any University.
3. The subject is of sufficient scope to keep the candidate engaged for two years.
4. The subject will lead to a valuable contribution. I have seen and approved the outline of proposed research work submitted by the candidate.
5. I have .....1..... (give numbers) Research candidates registered under my supervision and the serial number of this candidate whose application is being forwarded for registration is .....3..... (give the serial number)
6. The candidate is not in a close relation (the term of close relation is defined in the examination ordinance of the University)

25.5.16

Lecturer
Samrat Prithviraj Chauhan
Govt. College, Ajmer

Signature of the Supervisor with date

Certified that the available facilities will be extended to **Smt. ANNU BHARDWAJ** for research work if he/she is registered for Ph.D.

Principal
Samrat Prithviraj Chauhan
Govt. College, Ajmer

Signature of the Principal/ Director of the Institution with date

25/5/2016

Lecturer
Samrat Prithviraj Chauhan
Govt. College, Ajmer

Signature of the Head, Department with date

APPENDIX – IV – A

Format for outline (Synopsis) of Proposed Research Work
(to be Supplied in four Copies)
(Reference Ord. 124.11)

1. **NAME OF SCHOLAR (In English)** : Mrs. ANNU BHARDWAJ
   (In Hindi) : श्रीमती अन्नु भारद्वाज

2. **TITLE OF THE RESEARCH WORK :**
   (In English) : PHYTOCHEMICAL IMPORTANCE OF SOME MEDICINAL PLANTS AS SOURCE OF ANTICANCER AGENTS
   (In Hindi) : कैंसररोधी कारक के स्त्रोत के रूप मे कुछ औषधीय पादपो के पादपकीय रसायनिक महत्व

3. **LOCATION :**
   A. **INSTITUTION / DEPARTMENT WHERE THE WORK IS TO BE DONE** : Department of Botany, Samrat Prathviraj Chauhan Government College Ajmer

   B. **GEOGRAPHICAL AREA OF INVESTIGATION, IF ANY.** : Semi Arid Regions of Ajmer and Nagaur

4. **INTRODUCTION IMPORTANCE OF PROPOSED INVESTIGATION, OBJECTIVE.** : Annexure - 1

5. **REVIEW (WORK ALREADY DONE ON THE SUBJECT OF PROPOSED RESEARCH STUDY.)** : Annexure - 2

6. **RESEARCH GAPS INDENTIFIED IN THE PROPOSED FIELD OF INVESTIGATION. (BASED ON THE REVIEW)** : Annexure - 3

7. **MAJOR HYPOTHESIS, IF ANY.** : Annexure – 4

8. **RESEARCH METHODOLOGY.** : Annexure - 5

9. **LIST OF REFERENCE CITED.** : Annexure - 6

Anu Bhardwaj

.....

SIGNATURE OF THE CANDIDATE WITH DATE

OUTLINE APPROVED.

25.5.16

Lectprer

Samrat Prithviraj Chauhan Govt. College, Ajmer

.....

NAME & SIGNATURE OF SUPERVISOR WITH DATE & SEAL.

Annexure - 1

4. INTRODUCTION IMPORTANCE OF PROPOSED INVESTIGATION, OBJECTIVE.

4.1 . INTRODUCTION

In India, Ayurvedic system envolved over 5000 years ago and still in practice. The Regveda and Atharva Veda have included more than 700 medicinal prescription (mnimch 1996). Other system of medicine such as the Chinses, Unani and Sidda traditions have their roots in Ayurveda. All Indian Ayurveda system are mostly based on the plants and plant products that are available in Indian region.

Rajasthan has a large population of about approximate 6.2 crore. Around 80 percent live in villages which utilizes local medicine. The people of Rajasthan can be broadly divided into; those living into extreme weather condition as in Western Rajasthan and others in milder climate.

Rajasthan has rich biodiversity consisting of a large number of plants, some of which are used for their medicinal value. Although flora of Rajasthan has been compiled by Bhandari (1978) and Sharma (1976) but detailed information about their medicinal properties are lacking. A large number of medicinally important tree species are present on Aravalli hill range and other areas including less hospitable North-West Rajasthan. An attempt was made to characterize tree species of the region and detailed pharmacognostical studies on them are in progress. Several tribes of Rajasthan used the traditional system of medicine.

The tribals further enrich the ethnic heritage of Rajasthan, These ethnic groups are widely spread throughout Rajasthan and have considerable communication with each other. These ethnic groups depend on forest (mostly their surrounding vegetation) wealth are the real custodians that safeguard the medicinal plants till now. Rapid deforestation caused by over–harvesting and exploitative trade of medicinal plants has significantly reduced the availability of the medicinal plants in arid and semi–arid region of Rajasthan (Srivastva, 1977; Singh, 1983; Sinha, 1994; Pandi et al., 1996 and Harsha et al., 2002). As a result, most of the ethno botanical information's is passed by one group or to the other some of the notable works done in Rajasthan for ethno botanical point of view are medicinal plants of Ajmer forest division (Dixit and Mishra, 1982) ; Medicinal plantlore of the tribals of eastern Rajasthan (Singh and Pandey, 1982).

Generally, wasteland plants are called as weeds and said to be unwanted and undesirable plant species. On the contrary as suggested by 'Ayurveda' has said, "No plant of this world is useless"

These ethnic groups of Rajasthan mostly live in the rural areas and cannot afford to the luxury of costly modern medicine. They depend on vegetation surrounding them and make perfect uses of them for their medicinal needs (Upadhyay, 1997). The present investigations were undertaken for collection of important medicinal plants from Semi arid regions of Thar desert Rajasthan mainly Ajmer and Nagaur (Aravalli hill range).

4.2.1 WHAT IS CANCER ?

Cancer is derived from the Greek word Karkinos, Which means "Crab". Early physicians noted that the extensive collection of veins surrounding tumors looked like the claws of a crab. Cancer is a class of diseases characterized by out-of-control cell growth. There are over 100 different types of cancer, and each is classified by the type of cell that is initially affected. Cancer harms the body when altered cells divide uncontrollably to form lumps or masses of tissue called tumors (except in the case of leukemia where cancer prohibits normal blood function by abnormal cell division in the blood stream). Tumors can grow and interfere with the digestive, nervous, and circulatory systems, and they can release hormones that alter body function. Tumors that stay in one spot and demonstrate limited growth are generally considered to be benign. More dangerous, or malignant, tumors form when two things occur:

1. a cancerous cell manages to move throughout the body using the blood or lymphatic systems, destroying healthy tissue in a process called invasion
2. that cell manages to divide and grow, making new blood vessels to feed itself in a process called angiogenesis.

When a tumor successfully spreads to other parts of the body and grows, invading and destroying other healthy tissues, it is said to have metastasized. This process itself is called metastasis, and the result is a serious condition that is very difficult to treat.

4.2.2. What Causes of cancer ?

Cancer is ultimately the result of cells that uncontrollably grow and do not die. Normal cells in the body follow an orderly path of growth, division, and death. Programmed cell death is called apoptosis, and when this process breaks down, cancer begins to form. Unlike regular cells, cancer cells do not experience programmatic death and instead continue to grow and divide. This leads to a mass of abnormal cells that grows out of control.

Each cancer is thought to first start from one abnormal cell. What seems to happen is that certain vital genes which control how cells divide and multiply are damaged or altered. This makes the cell abnormal. If the abnormal cell survives it may multiply out of control into a cancerous (malignant) tumour.

We all have a risk of developing cancer. Many cancers seem to develop for no apparent reason. However, certain risk factors are known to increase the chance that one or more of your cells will become abnormal and lead to cancer. Risk factors include the following:

Chemical carcinogens : A carcinogen is something (chemical, radiation, etc) which can damage a cell and make it more likely to turn into a cancerous cell. As a general rule, the more the exposure to a carcinogen, the greater the risk. Well-known examples include:

* **Tobacco**. If you smoke, you are more likely to develop cancer of the lung, mouth, throat, oesophagus, bladder and pancreas. If you stop smoking, your risk goes down considerably.

* **Workplace** chemicals such as asbestos, benzene, formaldehyde, etc. If you have worked with these without protection you have an increased risk of developing certain cancers.

Age : The older you become, the more likely that you will develop a cancer. This is probably due to an accumulation of damage to cells over time. Also, the body's defenses and resistance against abnormal cells may become less good as you become older. For example, the ability to repair damaged cells, and the immune system which may destroy abnormal cells, may become less efficient with age. So, eventually one damaged cell may manage to survive and multiply out of control into a cancer. Most cancers develop in older people.

Lifestyle factors : Diet and other lifestyle factors (and, as mentioned, smoking) can increase or decrease the risk of developing cancer. For example:

* If you eat a lot of fruit and vegetables you have a reduced risk of developing certain cancers. The exact way in which they protect against cancer is not fully understood. These foods are rich in vitamins and minerals, and also contain chemicals called antioxidants. They may protect against damaging chemicals that get into the body. We should all eat at least five portions of fruit and vegetables per day.

* Eating too much fatty food possibly increases the risk of developing certain cancers.

* The risk of developing certain cancers is increased by obesity, lack of regular exercise, drinking too much alcohol and eating a lot of red meat.

· Research study looked at lifestyle factors and rates of cancer. The study concluded that by following recommendations on keeping physically active, keeping weight in check, not smoking, drinking alcohol in moderation and having a healthy diet, the risk of developing bowel cancer could be reduced by as much as 23%. But, the study found that even improving in some of these lifestyle factors had some reduction in risk.Exercise can help cancer patients fight fatigue.

Radiation : Radiation is a carcinogen. For example, exposure to radioactive materials and nuclear fallout can increase the risk of leukemia and other cancers. Too much sun exposure and sunburn (radiation from UVA and UVB) increase your risk of developing skin cancer. The larger the dose of radiation, the greater the risk of developing cancer. But note: the risk from small doses, such as from a single X-ray test, is very small.

Infection : Some germs (viruses and bacteria) are linked to certain cancers. For example, people with persistent infection with the hepatitis B virus or the hepatitis C virus have an increased risk of developing cancer of the liver. Another example is the link between the human papillomavirus (HPV) and cervical cancer. Most (possibly all) women who develop cervical cancer have been infected with a strain (subtype) of HPV at some point in their life. Another example is that a germ (bacterium) called Helicobacter pylori is linked to stomach cancer.

Immune system : People with a poor immune system have an increased risk of developing certain cancers. For example, people with AIDS, or people on immunosuppressive therapy.

Your genetic make-up : Some cancers have a strong genetic link. For example, in certain childhood cancers the abnormal gene or genes which may trigger a cell to become abnormal and cancerous are inherited. Other types of cancer may have some genetic factor which is less clear-cut. It may be that in some people their genetic make-up means that they are less resistant to the effect of carcinogens or other factors such as diet.

The World Health Organization estimates that, worldwide, there were 4 million new cancer cases and 8.2 million cancer-related deaths in 2012 (their most recent data).

There is a great need to address this epidemic disease with more effective therapeutic and preventive strategies, which could be possible with the use of natural compounds. Recently the scientific world has experienced an upsurge of interest in the therapeutic potential of medicinal plants as a source of promising anticancer agents. However, the application of plant-based compounds for the treatment of cancer can be traced back to 1950s. Some of the very first anticancer agents derived from plants are vinca alkaloids, vinblastine, vincristine, and cytotoxic podophyllotoxins. Statistical data suggest that 16 plant-derived anticancer drugs have been subjected to clinical trials thus far (Belayachi et al., 2013).

These discoveries have propelled the scientific interest of various research groups in the discovery of new anticancer agents from all-natural product sources, inclusive of plant secondary metabolites. The emerging importance of natural anticancer agents demands more research and experimentation in order to develop successful natural therapeutic options for this disease.

This review focuses on the phytochemical aspect of some of the potential anticancer medicinal plants with data gathered from the scientific literature.

Thus, the present review aims to assemble information on some of the medicinal plants that possess anticancer properties and thus great potential for cancer treatment.

4.3 OBJECTIVE

The patterns of are clear ; Discoveries are frequent, laboratory testing constitute a daunting course that private drug companies are sometime reluctant to assume Thousands of extracts are tested to find one new botanical medicine that is effective and non toxic to allow to use in therapy. Cannabinoids molecules of Cannabis sativa enhance the function of the immune system, as an antioxidant that neutralized free radicals cannibidiol may able to stop the stroke related damage, its role also in Alzhemeir and Parkinsonia disease and cannabidiol may have a role in treating these conditions. Beside research on the antimalarial properties of the genus Artemisia, Chinese medicine offers many areas for investigation. Traditional healing practiced in China incorporates millennia of experience of ills in humans. Chinese physicians use complex plant mixture sorting out secondary compounds which is useful in therapies. They also use club mosses such as ***Huperzia serrata*** contain alkaloid huperzine. ***Trichosanthes kirilowi*** is a source of trichosanthin use in therapy The protein MAP 30 isolated from Momordica charantia act against AIDS

New botanical medicines may begin as herbal remedies taken traditionally as tea extracts any later better understood for their chemistry and range of medicinal uses. Opium was the first use as a extract in tonics but now it is a controlled prescription drug with dosages and effects as an analgesic that are well understood. Global exchange of information and new respect for ethno botanical knowledge will move poorly known secondary compounds will be come valued pharmaceutical medicines.

Although a lot of recent investigations have been carried out for advancements in the treatment and control of cancer progression. significant work and room for improvement remain. The main disadvantages of synthetic drugs are the associated side effects. However natural therapies, such as the use of the plants or plant derived natural products are being beneficial to combat cancer.

Annexure – 2

5. REVIEW (WORK ALREADY DONE ON THE SUBJECT OF PROPOSED RESEARCH STUDY.)

Cancer is a major public health burden in both developed and developing countries. Plant derived agents are being used for the treatment of cancer. Several anticancer agents including taxol, vinblastine, vincristine, topotecon are derived from epidophyllotoxin are in clinical use allover the world. Agents such as Flavopridol, rescovitine, A-4 betulinic acid and silvistrol are in clinical use.

Natural products, especially plants have been used for the treatment of various diseases for thousand of years. Egypt, India, China and Greece used plant as a medicines. The first record on the medicinal uses of plants appeared in about 2600BC from Sumerians and Akkaidians **(Samulesson, 1999).**

The chinease material Medica,which describes more than 600 medicinal plants has been documented about 1100BC **(Cragg 1997)** Documentation of the Ayurvedic system recorded in **(Kapoor, 1990)** The WHO estimates that approx 80% of the world inhabitant rely on the traditional medicine for their primary health care. **(Fransworth et al 1985)** The National Cancer Institute collected about 35,000plant samples from 25 countries and has screened around 114000 extracts for anticancer activity **(Shoeb 2005).**

The isolation of vinca, viniblastine from ***Catharanthus roseous*** introduced a new era in the anticancer agents. These are in used in combination with other cancer chemothear peutic drugs for treatment of various cancers **(Cragg and Newman, 2005).**

The discovery of paclitaxel from the bark of ***Taxus bravifolia*** is another evidence of the success in natural product drug discovery. ***Taxus bacaata*** was reported to use in Ayurvedic medicine for cancer .

Paclitaxel is active against ovarian and breast cancer **(Rowinsky 1992)** Topotecan and Irinotecan are semiderivative of ***Camtothecin acuminata*** are used for treatment of cancer **(Cremeers and Bertino , 1997).** Etoposide and teneposide are two semi synthetic agents derived from ***Podophyllum*** are used for treatment of lymphomas and testicular cancer. Homoharringtonnie isolated from Cephlotaxu is used as anticancer agentes. Elliptinumisolated from Bleekeria vitenis for treatment of breast cancer **(Cragg and newmann, 2005).** Flavoupiridol isolated from ***Dysoxylum binectiferum*** is usedfor treatment of leukemia and solid tumours.Synthetic agent rosovitin isolated from ***Raphanus sativus*** use for treatment .Combretastatins and Cobretastatin isolated from bark of ***Combretum caffrum*** active against lung and leukemia **(Ohsumii et.al 1998).** Betulinic acid was isolated from Zizphus mauritiana active against human melanoma cell lines **(Balanus et.al 2005)** Perivilline isolated from ***Erythoxylum perivilli*** **(Silvi et al 2001)** It is active against multi drug resistance oral epidermoid cancer line in the presence of anticancer viniblastine. Silvistrol exhibited cytotoxocity against human colony cancer cell lines. However ,further investigation are necessary for their use as anticancer agents.

Annexure – 3

6. RESEARCH GAPS INDENTIFIED IN THE PROPOSED FIELD OF INVESTIGATION. (BASED ON THE REVIEW)

Natural products, especially plants have been used for the treatment of various diseases for thousand of years. However, the application of plant-based compounds for the treatment of cancer can be traced **back to 1950s**. Some of the very first anticancer agents derived from plants are vinca alkaloids, vinblastine, vincristine, and cytotoxic podophyllotoxins. Documentation of the Ayurvedic system recorded in **(Kapoor ,1990)**.

The isolation of vinca, viniblastine from ***Catharanthus roseous*** introduced a new era in the anticancer agents. These are in used in combination with other cancer chemothear peutic drugs for treatment of various cancers**(Cragg and Newman ,2005).**

Landmarks of these clinical trials are flavopiridol, isolated from the Indian tree ***Dysoxylum binectariferum***, and meisoindigo, isolated from the Chinese plant ***Indigofera tinctoria***, which have been documented to have less toxicity than conventional chemotherapeutic anticancer drugs **(Saklani and Kutty, 2008).**

Statistical data suggest that 16 plant-derived anticancer drugs have been subjected to clinical trials thus far **(Belayachi et al., 2013)**.

Most of the ethno botanical information's is passed by one group or to the other some of the notable works done in Rajasthan for ethno botanical point of view are medicinal plants of Ajmer forest division (Dixit and Mishra, 1982) ; Medicinal plantlore of the tribals of eastern Rajasthan (Singh and Pandey, 1982).

Yes, Literature of researches revels that some work has been done by various researcher, What though articles and reviews on said research have frequently appeared in various journals.

This besides since my proposed study will be the first ever detailed one on morphological and anatomical features of medicinal plant which are used as a anticancer agent.

This said that however the research still remains that no full length study has so far been conducted on anticancer agent isolated from medicinal plant.

Annexure – 4

7. MAJOR HYPOTHESIS, IF ANY

The aim of research to take a account about the carcinogenic agent and to analyze chemical constituents of the plant which is beneficial for the cancer treatment and act as a anticancer agent. also in vitro analysis of chemical constituent of medicinal plants beneficial for treatment of cancer.

Annexure – 5

8. RESEARCH METHODOLOGY

Recognizance surveys and visits will carried out in the villages selected area of Ajmer and Nagaur in order to intimate the residents of the aims and objectives of the study and enlist their support for the study.

Principal and practices of good manufacturing, standard operating procedures and utilization are always at question ? As assurance of quality of drug and formulations with regard to its composition, efficacy and genuineness in term of measurable parameters without violation of classics of Ayurveda, validation of process, storage, packaging disposal of waste, cost-benefit and quality control of single herbal drug can be achieved by under taking the following characteristics :

Use of any drug largely designated by morphologists based on the organelle which is under use. They can named and classified as –

1. Radix / Root
2. Tubera / Tubers
3. Rhizoma / Rhizome
4. Rhizoma and radix / Rhizome and Root
5. Conrtex / Bark
6. Lignum / Wood
7. Folia / Leaf
8. Flores / Flower
9. Fructus / Fruits
10. Semen / Seed

11.Herba / Herb

12.Unorganized

13.Amylum / Starches, etc.

Similarly a phyto-chemist a chemist looking to the natural a products irrespective of the organ / plant at chemical – looks at chemical constituents that may be therapeutically active or inactive active principles such as alkaloids, glycosides, steroidal glycoside, saponine glycosides, anthracene glycosides, cyanogenetic glycoside, flavonoid glycoside, resinous glycoside, sugars, tannins, volatile oils, lipids, waxes, gums, resin oleo-resins, gum resins, oleogum resins, balsams, bitter principles, organics acids, carbohydrates etc.

The therapist looks at the drug with behavioral aspects in totality,that is Rasa (6), the effect realized on the tongue; Guna (20), quality in terms of absorption effect; Veerya- potency (2), the resultant effect on the body and organs vipaka(3), teste on digestion and transformation for long term affect in body; proabhava, specific and ultimate effect on the body for curing ailing humanity.

Thus for standardization of any drug it is mandatory to examine it keeping this key in mind.

8.1 Sample for Examination :

The sample of any medicine should be drawn such that it becomes representative of the entire bulk. The course of sample drawing should be followed as shown below.

After drawing, the sample should be mixed uniformly and selected in sterile / dry container and label giving the following information of the

product should be pasted and a copy in sealed plastic paper may be kept inside and outside and outside the packing.

1. Name of sample (with local name)
2. Date of collection
3. Name of supplier
4. Expected test

A copy may be forwarded by post separately to the testing lab. At the same time, a copy may be kept for records along with representative being forwarded.

8.2 Examination of Sample :

As soon as the sample is received, it should be entered in a records accession register from where it may be forwarded for testing to the different sections.

(i) Physical examination

(ii) Morphological and anatomical section.

(iii) Phyto-chemical section

8.3 Physical Examination

(a) The sample received should be divided into three major groups for distribution with similar code.

(b) The sample may be examined by naked eye or with hand lens so as to understand to which part of the plant in belongs. Moreover by experience to understand what the sample is end is under use properly in which system of medicine, that is, Ayurveda, unani, ? Homeopathy, folklore or a totally new drug for the testing

organization. If new, a reference sample may be kept for comparison in future.

If known, the drug or the sample highly toxic. Separate coloured packing should be used for highly toxic samples and great care should be taken while handling such samples.

Parts of such sample may be forwarded for

(i) Morphological and anatomical study;

(ii) Phyto-chemical study ; and

(iii) For therapeutic study

8.4 Morphological and anatomical study

a) Dermal study

b) Study of surface architecture

c) Shape, Size, Colour

d) Type of fracture

e) Dermal study (Outer protective covering like epidermis, peridern

f) Fundamental tissue study

g) Vascular and stellar study

8.5 Criteria for selecting medicinal plants

8.6 Proof of efficiency

8.7 Safety

8.8 Popularity

8.9 Availability

8.6. Factors affecting the contents of active constituents of medicinal plants

a) The species

b) The geographical sources

c) The stage of growth

d) Conditions of cultivation

e)Time and season of cultivation

f)Parts used

g) The way of drying, storage, etc

8.7. Essential items for better use of Medicinal plants and plants derived products in traditional and scientific medicines

a) The botanical identity and purity of plants and the parts there of should be established in order to check experiments and research data.

b) Deposition of a voucher sample of the investigated plants in an easily accessible herbarium .

c) Detailed prescriptions for collection, cultivation, storage, production of total extracts ,tincture , purified extracts chemically pure compounds for therapeutic uses

d) Protection of wild growing plants against extinction and the conservation of threatened species

e) Cultivation of medicinal plants that are used in large quantities in traditional medicine or as raw material for industrial purposes research study in the field of new production techniques

f) Compilation of complete documentation and bibliographyon plants used in medicines

g) Collaboration with traditional healers in order to obtain the most valuable information on plants from their oral and personal knowledge

h) Chemical isolation of the active principles of medicinals plants

i) Qualitative and quantitative determination of the active principles of the plant standardization of the crude drug preparations .

j) Determination of the effectiveness and safety of the plants extracts and pure compounds and their use in medicines.

8.8 Starch Grains

Small spherical structures which can be easily identified by staining with iodine and use as a tool. Many plant rhizomes and stem bark have reserve food material in form of starch grains.

8.9. Leafy drugs

a) Epidermal study

(i) Simple epidermal cells –Datura

(ii) Beaded epidermal cells –Digitalis

b) Trichomes

(i) Unicellular (food and body) –Senna

(ii) Unicellular lignified --Tea

(iii) Multicellular –Datura

(iv) Branched –Verbascum / Anisochilous camosus

(v) Collapsed –Digitalis

(vi) Glandular sessile quadri cellular –Vasaka

(vii) Glandular multicellular and uniseriate –Datura

(viii) T-shaped Hiptage benghalenesis

(ix) Stellate –Solanum tuberosum

c) Stomata

(i) Anomicytic – Eucalyptus

(ii) Anisocytic – Datura, Sesbenia

(iii) Paracytic – Senna, Cajanus cajan

(iv) Diacytic – Vasaka, Andrographic

d) Cystolith

(i) Calcium carbonate – Vasaka

e) Sphaeraphides

(i) Calcium oxalate -- Hiptage

f) Prisms

Senna, Cajanus cajan, Anisomelus

g) Crystals in cluster

Senna, Datura

h) Acicular Crystals

Urgenia indica, Andrographics

8.10. Chromatographic Studies – TLC/ HPTLC

1) Volatile oils

Solvent systems –Ethyl acetate ; toulen (7.93)

Spraying Reagent – Vanillin

(i) Eucalyptus sp—5 Cineole

(ii) Mentha sp – 8Methanol , Piperitone

(iii) Eugenia carophyllata – 4 Eugenol

(iv) Cinnamomum zeylanicum – 4 cinnamaldehyde

(v) Zinger – 6zingiberene

(vi) Carum carva – 7 caravone

(vii) Corainder sativum -- 3 linalol

(viii) Foeniculum – 5 anethole , fencnole

(ix) Elettaria cardamomum—5 opemme

(x) Piper nigrum – Piperine

Solvent system : Ethyl acetate : Toulene : Diethylamine (2:7:1)

Spraying Agent : Dragedroff Reagent

Datura, Vasika, Aconite, Rauwolfia

Solvent system : Ethyl acetate : Methanol :Water (100: 13.5: 10)

Spraying Agent

Tea, Coffee

Solvent System : Ethyl acetate : n propanol :water (4:4:3)

Annexure – 6

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